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(71) Applicant(s)
Russell John Searle
5 Thurloe Square, LONDON, SW7 2TA,
United Kingdom

(72) Inventor(s)
Russell John Searle

(74) Agent and/or Address for Service
Russell John Searle
5 Thurloe Square, LONDON, SW7 2TA,
United Kingdom

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GB 2193938 A EP 0569954 A US 4221275 A
US 3961678 A

(58) Field of Search
UK CL (Edition O) B7H HC HXB HXG HXJ
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(54) Auxiliary electric propulsion for a pedal-driven vehicle

(57) In a pedal-driven vehicle, such as a bicycle, the pedalling force acts through a flexible drive member A on a movable idler wheel C to operate a switch and so energise an electric motor to assist the pedaller. The motor may only operate after a predetermined number of strokes of the pedal have been detected. The motor drives a wheel through a roller G which is mounted on a pivot such that the pressing force thereof increases with the assisting force. The roller is also driven through a free-wheel mechanism.

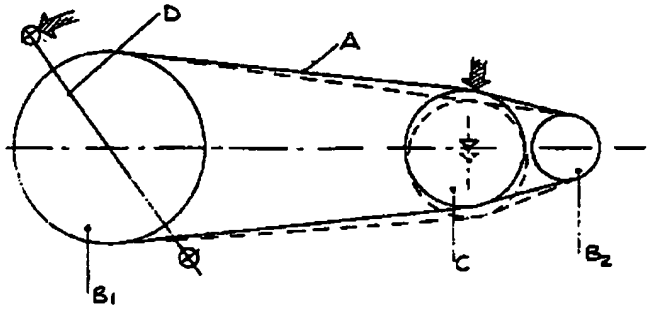

Fig 1

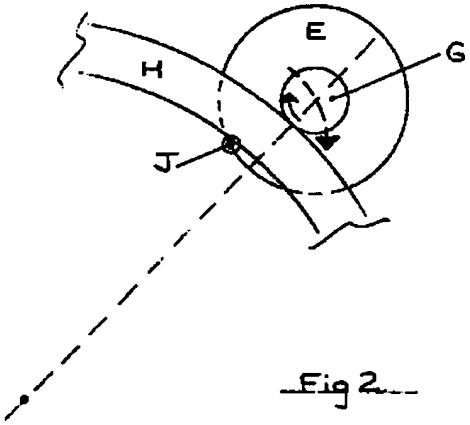

Fig 2

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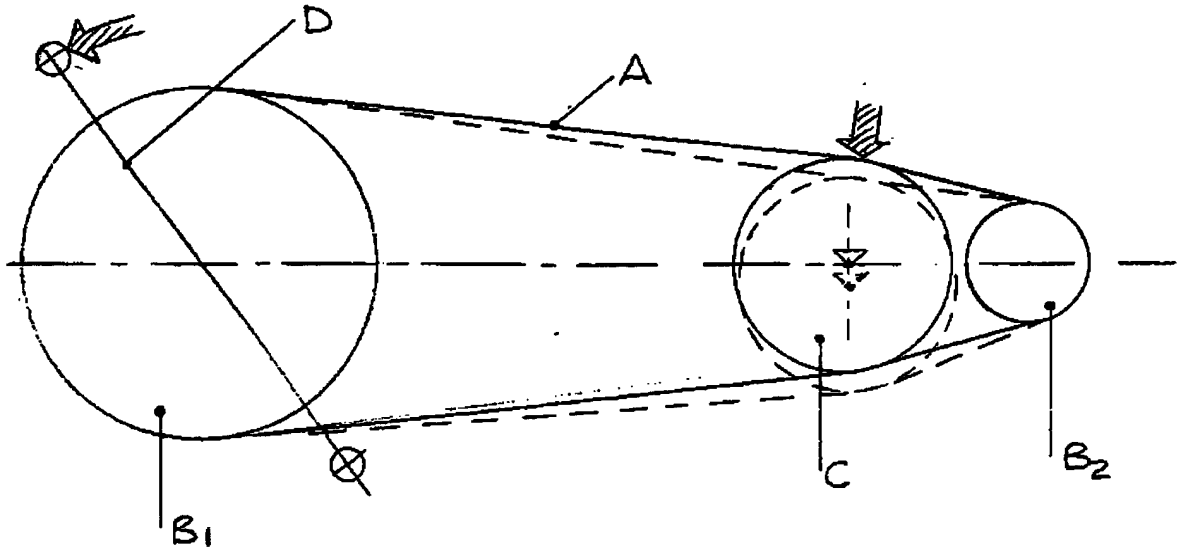

Fig 1.

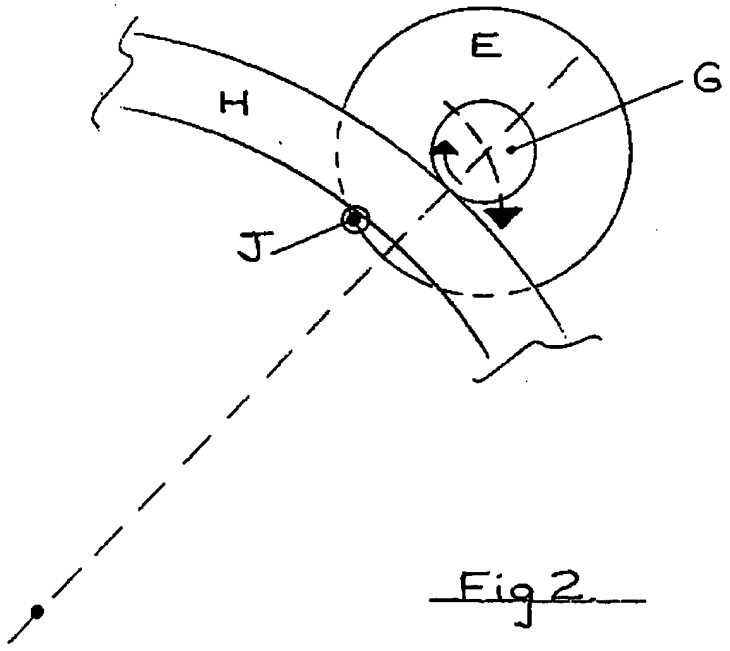

Fig 2.

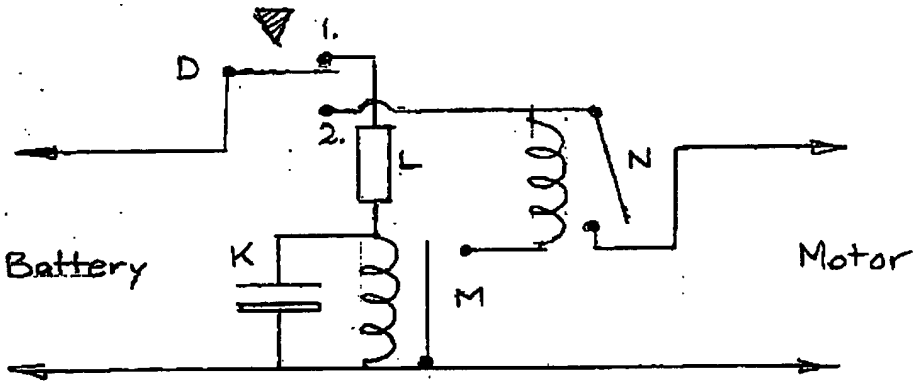

fig 3.

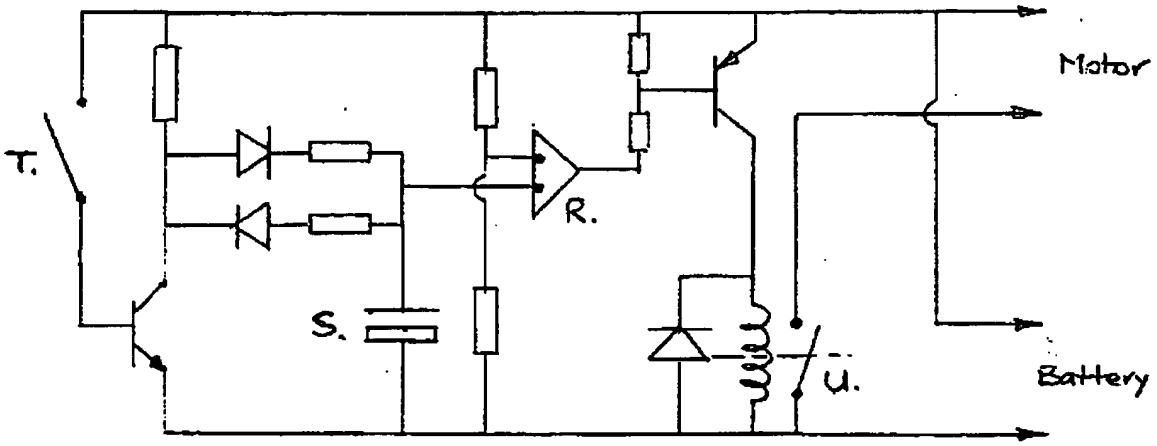

fig 4.

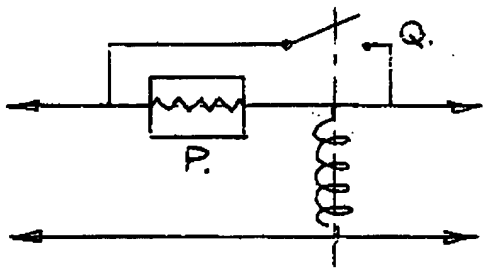

fig 5.

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IMPROVEMENTS IN AUXILIARY ELECTRIC PROPULSION

Successful auxiliary electric propulsion for pedal cycles for example, depends upon very low wastage and maximum utilisation of the energy available.

A major cause of wastage is the use of auxiliary power either when it does not provide maximum benefit to the rider or when it is not efficient in its use of the energy available.

The present invention reduces these inefficiencies by limiting the application of power to coincide with a predetermined minimum level of effort exerted on the pedals, thus reducing the effort required during complete or partial revolutions of the pedal crank.

In addition to this, power is not applied until a predetermined number and duration of pedal strokes, above a predetermined level of effort, is achieved. Thus when starting from rest or at the beginning of heavy effort, when the rider is not fatigued, auxiliary power is not applied.

Also mechanical losses in the servo action tyre drive system, which is chosen for its simplicity and adaptability, are reduced to a very low level being proportionate to the power transmitted. Also slip and tyre wear are effectively eliminated.

The result of these improvements is that a lightweight system is now capable of giving power assistance for an average journey of 25 KM, many times that possible with simple existing systems.

Described with reference to the drawings Fig. I is a method by means of which pressure on the pedals allows power to be transmitted to a wheel of the vehicle.

The pedal crank (D) is connected to the road wheel via a chain or belt (A) and toothed wheels (B_1 B_2), there being an idler (C) engaging with opposing parts of the chain and supported by it. The idler is of such diameter that opposing parts of the chain are

forced apart as shown. In response to pedal pressure, however, the upper part of the chain is tensioned and exerts a downwards force on the idler operating a switch engaging with the idler which energises the motor.

The motor (E) Fig. 2 which is compliantly attached to the vehicle by means of a leaf spring carries the roller (G) which is lightly biased against the tyre (H). The neutral axis (J). of the leaf spring intersects the wheel and is disposed forward of a line joining the motor and wheel axes, such that driving torque reaction on the motor tends to move the roller deeper into engagement with the tyre.

A method of preventing the application of power until a predetermined number and duration of pedal strokes have been made is shown in Fig. 3. The pedal pressure switch (D) in its non-activated position (1.) allows the capacitor (K) to charge via the resistor (L) holding the relay (M) in its open position. When pedal pressure moves the switch (D) into position (2.) the capacitor discharges through the relay (M) its voltage decaying until its contacts close, activating the relay (N) which closes the supply circuit to the motor via the switch (D).

In the arrangement shown in Fig 4. a differential amplifier (R) is used in a comparator circuit, the voltage build-up across the capacitor (S), due to electrical pulses from the pedal pressure operated switch (T) when it exceeds a reference voltage, changes the state of the differential amplifier which operates the relay (U), closing the motor circuit.

A method of supplying power progressively is shown in Fig.5. The negative temperature/resistance device (P) initially limits current taken by the motor until its resistance drops to a point where the relay (Q) closes, by-passing the device (P) and allowing it to return rapidly to its initial resistance.

A uni-directional clutch i.e. freewheel mechanism, may be interposed between the motor (E) and the roller (G).

The roller (G) may be provided with teeth of such a profile and pitch to produce a mating impression on the tyre.

CLAIMS

A first feature of the invention refers to a pedal or manually propelled vehicle having electric power assistance by means of roller drive to a tyre wherein an increase in pressure on the pedals is accompanied by an increase in pressure between roller and tyre and a simultaneous application of power to the roller.

A second feature of the invention refers to a pedal or manually propelled vehicle in which power assistance is operable in response to pedal pressure wherein such operation depends also on a predetermined duration of pressure impulses.

In a third feature of the invention according to the first and second features wherein the roller has its bearing compliantly attached to the vehicle. The roller is held in engagement with the tyre by spring means and urged more deeply into engagement in response to driving torque reaction on the bearing of the roller.

In a fourth feature according to the third feature wherein the compliant mounting has an axis which is substantially parallel to the wheel axis and intersects the diameter of the wheel, the roller moving in an arc which intersects the wheel.

In a fifth feature according to the third and fourth features wherein the compliant mounting consists of a spring under flexure or tension.

In a sixth feature according to any previous feature wherein a toothed idler wheel engages between opposing parts of a transmission belt or chain and is of such diameter to distort the chain from its natural path so that when one part is straightened due to pedalling torque, movement of the idler operates electrical means engaging the traction motor.

In a seventh feature according to any previous feature wherein pedal pressure operates an electrical switch which changes the state of charge of a capacitor to a point at which an electrical relay connects the traction motor.

In a eighth feature according to any previous feature wherein a freewheel mechanism is interposed between the motor and the driving roller.

In a ninth feature according to the third feature wherein power is applied to the driving motor via a negative resistance device there being electrical means to bypass the device when drive is engaged.

In an tenth feature according to any previous feature wherein the driving roller has teeth having a gear profile which create a mating impression on the tyre.

In a eleventh feature according to any previous feature wherein the vehicle is a bicycle.

In a twelfth feature according to any previous feature wherein that feature is constructed according to its forgoing description.

The Patent Office

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Claims searched: All

Examiner: Tom Sutherland
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The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

Switchboard
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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7H (HC, HXB, HXG, HXJ)

Int Cl (Ed.6): B62M 23/02

Other: EDOC, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2193936 A	(NORTH) See the Fig. and page 2 lines 75 to 85.	1, 2, 8, 11
Y	EP 0569954 A	(YAMAHA) See page 5 line 35 to page 6 line 25, pressure and duration of pedalling used to control assistance.	1, 2
Y	US 4221275	(PENNEBAKER et al) See Figs 1, 2 and 5 and column 1 lines 9 to 44.	1, 2, 3, 6, 8, 10, 11
Y	US 3961678	(HIRANO et al) See the figures and column 3 lines 3 to 34.	1, 2, 3, 6, 8, 10, 11.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.